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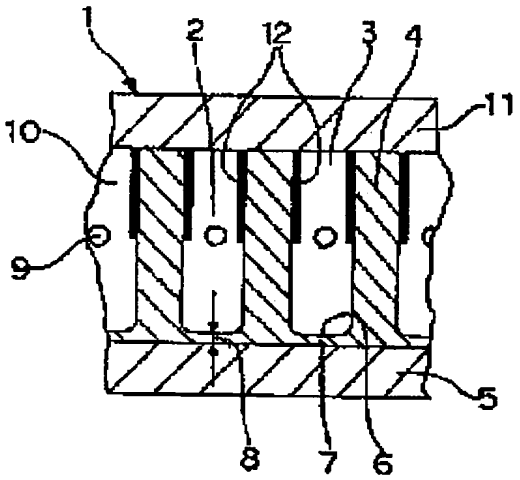
(54) PRINTING APPARATUS AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a printing apparatus having an ink-jet device comprised of an ink-jet head fit to mass produce and its manufacture whereby diaphragms can be tightly bonded onto a substrate thereby improving a bonding yield, defects such as breaks of the diaphragms or the like are reduced thereby improving a production yield, a diaphragm drive area can be highly accurately secured with a necessary minimum length of grooves, a jet characteristic is maintained high, the ink-jet head can be small and cost can be reduced.



SOLUTION: A plurality of grooves 3 are formed which constitute ink pressure chambers 2 of diaphragms 4 formed of a material having piezoelectric properties. A volume of the grooves 3 is changed by deflecting and deforming the diaphragms 4 by a shear mode of the material, whereby ink supplied to the grooves 3 is jetted as liquid drops from nozzle holes 9 set to one ends of the grooves 3 in an ink-jet head 1. The printing apparatus is provided with the ink-jet head 1 as an ink-jet device and includes a coat layer 7 of a thickness 8 of 200 μm with grooves in which channel bottom parts 6 are formed of the same material as the diaphragms 4.

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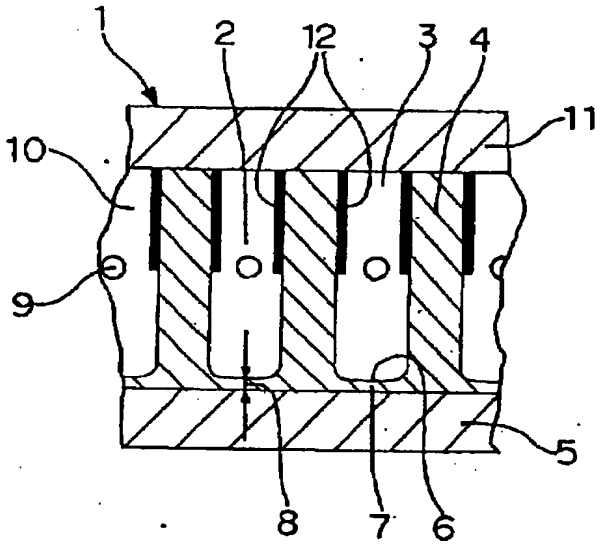
(54)【発明の名称】　印刷装置及びその製造方法

(57)【要約】
【課題】基板上に隔壁を強固に接着できて接着歩留りを改善でき、隔壁の破損等の欠陥を低減して製造歩留りを向上すると共に、隔壁駆動領域が必要最小限の溝の長さで高精度に確保でき、噴出特性を高く維持してインクジェットヘッドの小型化とコストの低減が可能となり、かつ量産に適したインクジェットヘッドから成るインク噴射装置を具備した印刷装置及びその製造方法を提供する。
【解決手段】圧電性を有する材料から成る隔壁４でインク加圧室２を構成する複数の溝３を形成し、前記材料の剪断モードにより隔壁４を歪み変形させて溝３の容積を変化させ、溝３の一端に設けたノズル孔９から溝３に供給されたインクを液滴として噴射するインクジェットヘッド１をインク噴射装置として具備した印刷装置で、流底部６が隔壁４と同一材料から成る厚さ８が２００μｍｍで、溝を有した被覆層７を有する。



【特許請求の範囲】
【請求項１】インク加圧室を構成する複数の溝を形成するための隔壁が、圧電性を有する材料から成り、該圧電性を有する材料の剪断モードにより隔壁を歪み変形させて溝の容積を変化させ、該溝に供給されたインクを溝と連通するノズル孔から液滴として噴射するインクジェットヘッドをインク噴射装置として具備した印刷装置であって、前記隔壁間の溝底部に該隔壁と同一材料から成る厚さ５～２００μmの被覆層が被着されていることを特徴とする印刷装置。
【請求項２】インク加圧室を構成する複数の溝を形成するための隔壁が、圧電性を有する材料から成り、該圧電性を有する材料の剪断モードにより隔壁を歪み変形させて溝の容積を変化させ、該溝に供給されたインクを溝と連通するノズル孔から液滴として噴射するインクジェットヘッドをインク噴射装置として具備した印刷装置であって、前記隔壁間の溝底部に該隔壁と同一材料から成り、厚さが２００μm乃至５００μmで、少なくとも一つの切欠溝を有する被覆層が被着されていることを特徴とする印刷装置。
【請求項３】インク加圧室を構成する複数の溝を形成する、側面に電極を備えた隔壁と、該隔壁で所定間隔に保持された対向する一対の基板と、前記溝の開放端を封着するノズル孔を有するノズル板とから成るインクジェットヘッドをインク噴射装置として具備した印刷装置の製造方法であって、前記隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填して固化させた後、成形型を脱型して隔壁及び溝底部をなす被覆層が一体的に成形された成形体を得たあと基板を貼り合わせ、しかる後、脱バインダー及び焼成して隔壁及び溝底部の被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、その後、隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする印刷装置の製造方法。
【請求項４】前記成形用組成物が重合性を有する有機物を含有することを特徴とする請求項３に記載の印刷装置の製造方法。
【請求項５】インク加圧室を構成する複数の溝を形成する、側面に電極を備えた隔壁と、該隔壁で所定間隔に保持された対向する一対の基板と、前記溝の開放端を封着するノズル孔を有するノズル板とから成るインクジェットヘッドをインク噴射装置として具備した印刷装置の製造方法であって、前記隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填して固化させた後、化学的処理により前記成形型を除去して隔壁及び溝底部をなす被覆層が一体的に成形された成形体を得たあと基板を貼り合わせ、しかる後、脱バインダー及び焼成して隔壁及び溝底部の被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、次いで隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする印刷装置の製造方法。
【請求項６】インク加圧室を構成する複数の溝を形成する、側面に電極を備えた隔壁と、該隔壁で所定間隔に保持された対向する一対の基板と、前記溝の開放端を封着するノズル孔を有するノズル板とから成るインクジェットヘッドをインク噴射装置として具備した印刷装置の製造方法であって、前記隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填し、基板を密着させて前記成形用組成物を固化させた後、化学的処理により前記成形型を除去してから脱バインダー及び焼成して隔壁及び溝底部の被覆層と基板とを焼結一体化するか、あるいは脱バインダー及び焼成の熱処理により前記成形型を分解除去すると同時に隔壁及び溝底部の被覆層と基板を焼結一体化した後、隔壁の側面に電極を形成し、次いで隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする印刷装置の製造方法。
【請求項７】前記成形型が、化学的処理あるいは熱処理により溶解あるいは分解可能な有機樹脂から成ることを特徴とする請求項５に記載の印刷装置の製造方法。
【請求項８】前記成形型は、基板上に感光性有機フィルムを接着し、所定形状のマスクパターンを合わせて露光及び現像を行う工程を、マスクパターンを変更しながら繰り返し、所定高さで所定断面形状を有する溝底部に所定厚さの被覆層を形成する凸部を被着形成したものであることを特徴とする請求項５又は請求項６に記載の印刷装置の製造方法。
【請求項９】インク加圧室を構成する複数の溝を形成する、側面に電極を備えた隔壁と、該隔壁で所定間隔に保持された対向する一対の基板と、前記溝の開放端を封着するノズル孔を有するノズル板とから成るインクジェットヘッドをインク噴射装置として具備した印刷装置の製造方法であって、基板上に所定形状の印刷製版を合わせてスクリーン印刷法にて圧電性を有する成形用組成物を印刷して固化させた後、印刷製版を変更して前記印刷、固化工程を繰り返して隔壁及び溝底部をなす被覆層が一体的に成形された成形体を成形した後、脱バインダー及び焼成して隔壁及び溝底部の被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、その後、隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を

構成するインクジェットヘッドを形成することを特徴とする印刷装置の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、微細なノズル孔からインクを液滴として噴射して印字、画像等を形成する印刷用の各種プリンターや記録計、ファクシミリ、あるいは捺染分野や窯業分野で文様形成等に適用されるインク噴射装置等に用いられる高精度かつ軽量小型のインクジェットヘッドを有する印刷装置及びその製造方法に関するものである。

【０００２】

【従来の技術】近年、マルチメディアの浸透に伴い、印刷が不要で少量多品種の用途に適した小型軽量の各種情報の印刷用インターフェイスとして、従来のインパクト方式のプリンタに代わって、インク噴射装置や熱転写装置等を利用したノンインパクト方式の各種印刷装置が開発され、これらの利用範囲が各種産業分野に拡大している。

【０００３】かかるノンインパクト方式のプリンタのなかでも、前記インク噴射装置は、多階調化やカラー化が容易で、ランニングコストが低いことから将来性が注目されている。

【０００４】前記インク噴射装置には、複数のノズル孔を有するノズル板と、インクの液滴を噴射させるための圧力を発生させるインク加圧室を主要な構成部品とするインクジェットヘッドが用いられており、該インクジェットヘッドは、一般的には、前記ノズル板と、該ノズル板のノズル孔からインクの液滴を例えば色毎に噴射させるために基板上に隔壁を設けて溝を形成したインク加圧室と、該インク加圧室を密閉する蓋の役割を成す上部基板等から構成されている。

【０００５】また、前記インクジェットヘッドにおいて、インク加圧室に圧力を発生させてインクの液滴を噴射する方式としては、必要なインクの液滴だけを噴射するドロップ・オン・デマンド型が主流になっており、具体的には、カイザー型やサーマルジェット型が代表的な方式として採用されている。

【０００６】前記カイザー型は、隔壁で複数の平行な溝を形成したインク加圧室を密閉する上部基板の少なくとも一部に薄壁を設け、該薄壁を圧電素子等で変形させてインク加圧室の流路の容積を変化させ、インク加圧室に内圧を発生させてインクを液滴として噴射させるものである。

【０００７】また、前記サーマルジェット型は、前記インク加圧室内の一部に発熱体を設け、該インク加圧室内のインクを沸騰させた際に発生する気泡の体積膨張を利用して内圧を発生させ、該インクを液滴として噴射させるものである。

【０００８】しかしながら、前記カイザー型は、上部基板の表面にさらに圧電素子等を設ける必要があることから、インクジェットヘッドとしては小型化が困難であり、また、前記サーマルジェット型は、インクに高熱を加えるためインク自体に耐熱性が要求され、インクの選択領域を狭めたり、インクを熱膨張させるために時間を要することから、応答性が劣る等の問題があった。

【０００９】そこで、前記問題を解決するために、圧電材料からなる基板上に平行に多数配置した溝を形成するための隔壁と、隔壁の側面に形成された電極と、隔壁の頂部に接合され、溝を密閉する上部基板とから成るインク加圧室と、インク加圧室の溝の開放端側に、溝と対応したノズル孔を有するノズル板を接合した構造を成すインクジェットヘッドから成る剪断モード型のインク噴射装置が提案されている。

【００１０】この提案では、電極に駆動電圧を印加し、圧電材料の剪断モード変形を利用してインク加圧室の溝を形成する隔壁を歪み変形させて溝の容積を変化させることにより、溝中のインクを加圧し、溝に連通したノズル孔から、インクの液滴を噴射するものである。

【００１１】この提案の剪断モード型のインク噴射装置を構成するインクジェットヘッドは、従来のカイザー型やサーマルジェット型のように、上部基板表面に圧電素子等を設置させる必要が無く、また、インクに耐熱性が要求されることもないことから、小型化が可能となり、しかも応答性に優れ、高速の印刷が可能となる等、注目に値するものであった。

【００１２】しかしながら、剪断モード型のインク噴射装置では、インクジェットヘッドのインク加圧室の溝を形成するのに、所要枚数重ねた薄い円盤状のダイヤモンドブレード等の切削具を回転しながら圧電材料から成る基板を切削して溝を刻設しているため、得られた溝の端部は、前記円盤状の切削具の曲率を転写した形状を成している。

【００１３】従って、所望の噴射性能を得るためには、隔壁を歪み変形させてインク加圧室に十分な内圧を発生させることが必要となり、十分な隔壁駆動領域を確保しなければならないことから、前記未切削分を考慮して溝を長く設ける必要があり、インクジェットヘッド自体が大きくなると共に、材料コストが増加するという欠点があった。

【００１４】また、前記基板に溝を形成するに際しては、前述のような薄い円盤状のダイヤモンドブレード等の切削具を用いた加工方法では、切削条件が非常に難しく、送り速度、切り込み量、回転数等が適合しないと、隔壁がチッピングを起こしたりする等の種々の問題があり、決して歩留り良く、低コストで量産に適した加工とは言い難いものがあった。

【００１５】そこで、さらに前記問題を解決するために切削屑が生じず、また、短時間で隔壁を形成できる露光埋め込み法等が提案されている（特開平７－３００３８

1号公報参照）。

【００１６】

【発明が解決しようとする課題】しかしながら、前記露光埋め込み法は、基板上に感光性樹脂組成物をフォトレジスト層として隔壁の凹部のパターンを形成し、得られた開口部に隔壁用のセラミック材料を充填した後、前記パターンを消失せしめることから、得られた隔壁成形体は、該隔壁成形体の基板上での被着面積が少ないために、隔壁が基板から剥離したり、欠損し易く、前記露光埋め込み法は必ずしも歩留まりの良い、低コストの製造方法とは言い難いという問題があった。

【００１７】

【発明の目的】本発明は前記課題を解決するために成されたもので、その目的は、基板上に形成された隔壁を強固に接着することができ、接着歩留まりを改善できる上、しかも、隔壁の破損等の欠陥を低減できて製造歩留りが向上すると共に、隔壁駆動領域が必要最小限の溝の長さで高精度に確保できて噴射特性を大きく劣化させることなく、インクジェットヘッドの小型化とコストの低減が可能となり、かつ量産に適したインクジェットヘッドから成るインク噴射装置を具備した印刷装置及びその製造方法を提供することにある。

【００１８】

【課題を解決するための手段】本発明者は、前記課題に鑑み鋭意検討した結果、剪断モード型のインク噴射装置において、前記基板上の隔壁間の溝底部に隔壁と同一材料から成る被覆層を一体的に設けることによって、基板上の隔壁を強固に密着することができ、しかも、前記基板上の隔壁間の溝底部及び隔壁を切削等の工具を用いることなく成形するために、従来の加工方法での曲率を有する未切削部分を不要として隔壁駆動領域を拡大することができることは勿論、前記溝の長さを必要最小限とすることができることを見出し、本発明に至った。

【００１９】即ち、本発明の印刷装置は、圧電性を有する材料から成る隔壁でインク加圧室を構成する複数の溝を形成し、前記隔壁を形成する圧電性を有する材料の剪断モードにより隔壁を歪み変形させて溝の容積を変化させ、該溝に供給されたインクを溝と連通するノズル孔から液滴として噴射するインクジェットヘッドをインク噴射装置として具備した印刷装置であって、前記隔壁間の溝底部に該隔壁と同一材料から成る厚さ５～２００μｍの被覆層を被着させたことを特徴とする。

【００２０】また、本発明の他の印刷装置は、圧電性を有する材料から成る隔壁でインク加圧室を構成する複数の溝を形成し、前記隔壁を形成する圧電性を有する材料の剪断モードにより隔壁を歪み変形させて溝の容積を変化させ、該溝に供給されたインクを溝と連通するノズル孔から液滴として噴射するインクジェットヘッドをインク噴射装置として具備した印刷装置であって、前記隔壁間の溝底部に該隔壁と同一材料から成り、厚さが２００μｍ乃至５００μｍで、少なくとも一つの切欠溝を有する被覆層を被着させたことを特徴とする。

【００２１】本発明の印刷装置の製造方法は、隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、鋳込み成形法により圧電性を有する材料から成る成形用組成物を充填して固化させた後、成形型を脱型して隔壁及び溝底部をなす被覆層が一体的に成形された成形体を得たあと基板と貼り合わせ、しかる後、脱バインダー及び焼成して隔壁及び溝底部をなす被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、その後、隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする。

【００２２】特に、前記製造方法に適用される成形用組成物は、重合性を有する有機物を含有すること好ましい。

【００２３】また、本発明の印刷装置の他の製造方法は、隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填し、基板を密着させて前記成形用組成物を固化させた後、化学的処理により前記成形型を溶解除去して隔壁及び溝底部をなす被覆層が一体的に成形された成形体を得たあと基板を貼り合わせ、しかる後、脱バインダー及び焼成して隔壁及び溝底部をなす被覆層と基板とを焼結一体化するか、隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填し、基板を密着させて前記成形用組成物を固化させた後、化学的処理により前記成形型を除去してから脱バインダー及び焼成して隔壁及び溝底部をなす被覆層と基板とを焼結一体化するか、あるいは隔壁及び該隔壁間に溝底部をなす所定厚さの被覆層を形成する凹部と溝用の凸部を有する成形型に、圧電性を有する材料から成る成形用組成物を充填し、基板を密着させて前記成形用組成物を固化させた後、脱バインダー及び焼成の熱処理により前記成形型を分解除去すると同時に隔壁及び溝底部をなす被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、次いで隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする。

【００２４】特に、前記化学的処理あるいは熱処理により成形型を溶解あるいは分解除去する製造方法でも用いる成形型は、化学的処理あるいは熱処理により溶解あるいは分解可能な有機樹脂により形成することが好ましく、さらに成形型として、基板上に感光性有機フィルムを接着し、所定形状のマスクパターンを合わせて露光及び現像を行い、この工程をマスクパターンを変更しなが

ら繰り返し、所定高さに積層して所定断面形状を有する溝底部に所定厚さの被覆層を形成する凸部を被着形成したものが最も好ましい。

【００２５】また、本発明の印刷装置のさらに他の製造方法は、圧電性を有する材料から成るペースト状の成形用組成物を、基板上に合わせた所定形状の印刷製版を用いてスクリーン印刷法にて印刷、固化して積層する工程を繰り返し、基板上に隔壁及び溝底部をなす被覆層が一体的に成形された成形体を形成し、しかる後、脱バインダー及び焼成して隔壁及び溝底部をなす被覆層と基板とを焼結一体化し、次いで隔壁の側面に電極を形成し、その後、隔壁の頂部に上部基板を接合すると共に、溝の開放端側にノズル孔を穿設したノズル板を接合してインク噴射装置を構成するインクジェットヘッドを形成することを特徴とする。

【００２６】

【作用】本発明の印刷装置及びその製造方法によれば、インク加圧室を構成する複数の溝を形成するための隔壁と同一材料で基板上の隔壁間をなす溝底部に所定厚さの被覆層が形成されていることから、基板と接する隔壁基部の被着面積が増加して該基板上に形成された隔壁を強固に接着することができ、隔壁の接着歩留りが改善され、その上、剪断モードによる隔壁駆動領域が確保され、同一のインク噴射特性を得るには溝を従来よりも短くでき、インクジェットヘッド自体が小型軽量化され、材料コストも低減できると共に、かかるインクジェットヘッドから成るインク噴射装置の組み込み時の占有面積も大幅に低減され、引いては印刷装置自体の小型化にも寄与する。

【００２７】さらに、インクジェットヘッドが小型軽量化されることにより、インクジェットヘッドの移動速度の高速化、位置決め精度の向上にも寄与することになる。

【００２８】

【発明の実施の形態】以下、本発明の印刷装置及びその製造方法について、図面に基づき詳細に説明する。

【００２９】図１は、本発明の印刷装置を構成するインク噴射装置に用いられるインクジェットヘッドの一例である溝の長手方向に対して直角方向に切断した要部を示す断面図である。

【００３０】図１において、１は基板５表面に被着され、インク加圧室２を構成する平行な複数の溝３を形成する圧電性を有する材料から成る隔壁４と、基板５表面に被着され、前記隔壁４と一体的に形成された溝底部６をなす所定厚さ８の被覆層７と、溝３の開放端側に接合されたノズル孔９を有するノズル板１０とを主要部とするインクジェットヘッドであり、隔壁４の頂部にはインク室（不図示）に連結する上部基板１１が接合され、隔壁４の側面には、駆動電界印加用の電極１２が形成されており、ノズル孔９はノズル板１０に各溝３と対応して列状に穿設されている。

【００３１】このインクジェットヘッド１において、前記被覆層７の所定厚さ８は、隔壁４と同一材料から成る厚さ５～２００μｍであることを特徴とし、前記被覆層７の厚さ８が５μｍ未満の場合、隔壁４の基板５との接着力及び接着歩留りの向上効果が少なく、他方、２００μｍを越えると、後述する隔壁４と溝底部６をなす被覆層７及び基板５とを焼成にて焼結一体化する際に、基板５との収縮度合いが相違するために、各溝底部６をなす被覆層７での収縮が阻害され、溝３幅寸法にバラツキが発生する。

【００３２】従って、本発明では、インク加圧室２が前記条件を満足して構成され、圧電性を有する材料の剪断モードにより隔壁４を歪み変形させて効率良く、かつ正確に再現性良く隔壁４の容積を変化できるものであれば、その断面形状はいかなるものでも構わない。

【００３３】次に、本発明の印刷装置を構成するインク噴射装置に用いられるインクジェットヘッドの他の例を図２に説明する。なお、図１と同一部分については同一符号で示す。

【００３４】図２において、２１は基板５表面に被着され、インク加圧室２を構成する平行な複数の溝３を形成する圧電性を有する材料から成る隔壁４と、基板５表面に被着され、前記隔壁４と一体的に形成された溝底部２６をなす所定厚さ２８の被覆層２７と、溝底部２６をなす各被覆層２７に形成された少なくとも一つの切欠溝２３と、溝３の開放端側に接合されたノズル孔９を有するノズル板１０とを主要部とするインクジェットヘッドであり、隔壁４の頂部にはインク室（不図示）に連結する上部基板１１が接合され、隔壁４の側面には、駆動電界印加用の電極１２が形成されており、ノズル孔９はノズル板１０に各溝３と対応して列状に穿設されている。

【００３５】このインクジェットヘッド２１において、前記被覆層２７の所定厚さ２８は、隔壁４と同一材料から成る厚さ２００μｍ乃至５００μｍであるとともに、被覆層２７に少なくとも一つの切欠溝を２３を有することを特徴とし、被覆層２７の厚さ２８を２００μｍより厚くすることで、図１に示すインクジェットヘッド１と比較して大きな接着力が得られ接着歩留りを改善でき、より大きな隔壁４を基板５上に接合できるとともに、切欠溝２３を設けたことで、後述する隔壁４と溝底部２６をなす被覆層２７及び基板５とを焼成にて焼結一体化する際に、これまで被覆層２７全体が収縮していたものを、一つ一つの隔壁４側に向かって被覆層２７の収縮が進むため、被覆層２７の厚み２８を厚くしても基板５上での隔壁４間のピッチが大きくばらつくことがなく、高精度に保つことができる。

【００３６】このような効果を有効に得るためには、切欠溝２３の深さを被覆層２７の厚さ２８の１／３以上とすることが好ましく、また隔壁４の強度を低下させるこ

となく、溝３内のインクの流れを乱さないようにするために、切欠溝２３の幅は、溝３の幅の３／４以下とすることが好ましく、これらの寸法範囲内であればどのような断面形状をしたものでも構わない。

【００３７】なお、溝底部２６をなす被覆層２７の厚み２８を５００μｍ以下としたのは、これより厚くなると、インクジェットヘッド自体が大きくなり、小型化が困難となるからである。

【００３８】そして、図２に示すインクジェットヘッドにおいても、図１のインクジェットヘッド１と同様にインク加圧室２が前記条件を満足して構成され、圧電性を有する材料の剪断モードにより隔壁４を歪み変形させて効率良く、かつ正確に再現性良く隔壁４の容積を変化できるものであれば、その断面形状はいかなるものでも構わない。

【００３９】なお、図１や図２のインクジェットヘッド１，２１では、ノズル板１０を溝３の開放端側に接合した例を示したが、上部基板１１や溝底部６，２６と基板５にノズル孔９を穿設したものでも良く、本発明の範囲を逸脱しない範囲で変更、改良できることは言うまでもない。

【００４０】次に、本発明の印刷装置の製造方法を、印刷装置の要部を成すインク噴射装置を構成するインクジェットヘッド１，（２１）の製造工程を図３に基づき説明する。

【００４１】図３において、１，（２１）は基板５と一体化した複数の平行な溝３を形成する圧電性を有する材料から成る隔壁４の頂部に接合した上部基板１１と、溝３の開放端側に接合したノズル孔９を穿設したノズル板１０とから成るインクジェットヘッドである。

【００４２】本発明の印刷装置の製造方法として、圧電性を有する材料から成る成形用組成物１４を、成形型１３の凹部に充填して隔壁４を成形する方法では、隔壁４及び溝底部６，（２６）をなす被覆層７，（２７）に相当する凹部と溝３用の凸部を構成する成形型１３を基板５上に載置し、上記凹部に圧電性を有する材料から成る成形用組成物１４を充填する工程から成る方法と、隔壁４及び溝底部６，（２６）をなす被覆層７，（２７）に相当する凹部と溝３に相当する凸部を有する成形型１３を用意し、上記凹部に圧電性を有する材料から成る成形用組成物１４を充填したあと、該成形用組成物１４に基板５を押し付ける工程から成る方法がある。

【００４３】なお、図３の製法において、図２に示すインクジェットヘッドの被覆層２７に切欠溝２３を形成する場合には、成形型１３の溝３用の凸部に予め切欠溝２３に相当する突起を形成しておけば良い。

【００４４】前記成形型１３に成形用組成物１４を充填する手段としては、公知のドクターブレード法やロールコーター法、印刷法、射出成形法等が採用し得るが、その際、充填前に脱気処理したり、あるいは充填後に脱気処理して充填物中に気泡が残留しないようにすることが望ましい。

【００４５】また、前記成形用組成物１４を充填する成形型１３と基板５とを密着させるには、両側が開放された成形型１３の一方側に予め基板５を密着させるかあるいは予め基板５を設置できる密閉型の成形型１３に成形用組成物１４を充填して密着させても良い。

【００４６】その後、前記成形用組成物１４に含有する樹脂に応じて適宜、例えば乾燥や冷却、加熱、露光、反応促進剤等の添加等の各種手段で固化させることができるが、最終的に隔壁４の形状及び溝底部６，（２６）をなす被覆層７，（２７）の形状を保形できれば、固化させる手段は特に限定するものでばなく、特に成形型１３を脱型する製造方法において、重合性を有する有機物を固化する場合には、加熱や露光、反応促進剤等の添加により最も効果的に固化することができる。その他にも、基板５上に被着形成した圧電性を有する均一な厚さの材料層をマスクパターンを介してサンドブラスト法で削り出し、隔壁４及び隔壁４間の溝底部６，（２６）をなす被覆層７，（２７）が一体的に成形された圧電性を有する材料から成る成形体１６を被着してなる基板５を形成することも可能である。

【００４７】さらに、インクジェットヘッドの製造工程の他の例を図４に示すように、基板５上にまず圧電性を有する材料を含むペースト状の成形用組成物１４を全面に均一な厚さで印刷し、その後、所定寸法の印刷製版１５を用いて積層印刷を繰り返して、隔壁４と隔壁４間の溝底部６，（２６）をなす被覆層７，（２７）とを同一材料により一体的に成形した成形体１６を基板５上に被着成形することもできる。

【００４８】なお、図４の製法において、図２に示すインクジェットヘッドの被覆層２７に切欠溝２３を形成する場合には、印刷製版１５に予め切欠溝２３に相当するパターンを形成しておき、この印刷製版１５を用いて圧電性を有する材料を含むペースト状の成形用組成物１４を印刷するようにすれば良い。

【００４９】かくして、隔壁４と隔壁４間の溝底部６，（２６）をなす被覆層７，（２７）が一体的に成形された圧電性を有する材料から成る成形体１６が被着された基板５を、公知条件の脱バインダー処理を施してから焼成することにより、同一材料や異なる材料から成る基板５と一体化された隔壁４及び流底部６，（２６）をなす被覆層７，（２７）を有するインク加圧室２の構成部材を作製することができる。

【００５０】また、必要に応じて引き出し電極用のわずかな空間を溝３の端部に機械加工にて形成することもできる。

【００５１】その後、隔壁４の頂端部から基部方向に分極処理を行い、基板５と一体化した複数の平行な溝３を有するインク加圧室２の構成部材を作製した後、隔壁４

側面の少なくとも一部及び溝３の端部に設けた僅かな空間に、駆動電界印加用の電極１２と引き出し電極（不図示）を、例えば、スパッタリング法やメッキ法、蒸着法、イオンプレーティング法、あるいはＣＶＤ法等により形成する。

【００５２】次いで、得られたインク加圧室２の構成部材に上部基板１１及びノズル孔９を穿設したノズル板１０をそれぞれエポキシ系接着剤等で接着して組み立てることにより、本発明の印刷装置を構成するインク噴射装置の剪断モード型のインクジェットヘッド１，（２１）を得ることができる。

【００５３】本発明において、前記基板５としては、隔壁４と同一の圧電性を有する材料材を用いることができることは勿論のこと、隔壁４と焼結後に一体化できるものであれば特に限定するものではなく、例えば、チタン酸ジルコン酸鉛系セラミック、ジルコニア、アルミナ等を挙げることができる。

【００５４】次に、前記成形型１３は、前記詳述したように所望の形状の隔壁４と隔壁４間の溝底部６，（２６）をなす被覆層７，（２７）を成形できるものであれば良く、例えば、金属型やセラミック型、樹脂型、ゴム型等の各種材質を用いることができるが、成形体１６を成形型１３から脱型する場合には、成形型１３の加工性及び寸法精度の観点から金属型が最適であり、また、一体型は勿論のこと分割型で構成されていても何ら問題はない．また、アルカリ液等の化学的処理により溶解除去できるもの、あるいは脱バインダー処理又は焼成の熱処理により分解除去できるもので前記成形型１３を構成することも可能であり、かかる成形型１３としでは、ワックスや感光性有機レジストに代表される有機樹脂等が最適である。

【００５５】さらに、前記成形型１３の表面に離型性を改善する等の理由により、離型剤を塗布したり、表面処理を施すこともできる。

【００５６】一方、前記成形用組成物１４は、圧電性を有する材料であれば特に限定するものでばなく、圧電すべり効果や圧電縦効果、圧電横効果等の各種圧電モードを利用できるものであればいずれでも良いが、なかでもチタン酸ジルコン酸鉛系のセラミック材料が最適である。なお、前記成形用組成物１４は、圧電性を有する材料以外に樹脂、溶剤等から成るバインダー溶液を混合したものであり、分散剤や増粘剤等の各種添加剤を添加することもできる。

【００５７】前記樹脂としては、熱可塑性のワックス類やアクリル系樹脂、ブチラール系樹脂を使用することができるのは勿輪のこと、特に重合性を有する有機物を含有することが、隔壁４の強度を高める観点から好ましく、例えば、不飽和ポリエステル樹脂やフェノール樹脂、エポキシ樹脂、ウレタン樹脂、紫外線硬化樹脂及び重合可能なモノマー等を好適に使用できる。

【００５８】前記成形用組成物１４を調製する手段としては、特に限定するものではないが、例えばボールミルやビーズミル、３本ロール、プラネタリー型撹拌機、遊星型撹拌機等を使用することができる。

【００５９】また、前記電極１２に適用できる材料としては、特に限定するものではないが、銅、銀、金、白金、タングステン、ニッケル等の金属材料や、ペロブスカイト系の導電性セラミック材料等が好適に使用することができる。

【００６０】他方、前記ノズル板１０は、レーザー等で所定寸法に穿孔してノズル孔９を形成したもので、その材料としては、各種プラスチックや金属、セラミックス等のいかなる材料をも使用することができ、例えば、ポリエチレンテレフタレートやポリイミド、ポリエーテルイミド、ポリエーテルケトン、ポリエーテルスルホン、ポリカーボネイト、酢酸セルロース等のプラスチック、あるいはステンレス鋼やクロムモリブデン鋼、アルミニウム等の金属、もしくばアルミナやジルコニア、チタン酸ジルコン酸鉛等のセラミックスが挙げられるが、特に、加工のし易さの観点からは、ポリエチレンテレフタレートやポリイミドから成るプラスチック板が好適である。

【００６１】なお、本発明の印刷装置では、噴射させるインクとして、顔料及び／又は染料と、水やアルコール等の水系の溶剤、あるいはヘキサンやトルエン等の非水系の溶剤を主成分としたもののいずれにも適用可能である。

【００６２】

【実施例】次に、本発明の印刷装置及びその製造方法について、以下のようにして評価した。

【００６３】（実施例１）まず、隔壁に相当する凹部の幅が約９０μｍ、深さが約５００μｍ、ピッチが約１４０μｍ、隔壁間の溝底部をなす被覆層に相当する凹部の厚さが約２５０μｍ、さらに溝となる凸部の幅が５０μｍ、深さが２５０μｍであるステンレス製の開放型の成形型を用意した。

【００６４】次に、チタン酸ジルコン酸鉛系セラミック粉末と不飽和ポリエステル樹脂、エチルジグリコール、ノニオン系分散剤から成る各原料を遊星型撹拌機にて混合した後、３本ロールを通して成形用組成物を調製した。

【００６５】その後、脱泡した成形用組成物を前記成形型に充填した後、厚さ約３００μｍのチタン酸ジルコン酸鉛系セラミック基板を成形型の開放部から所定位置に圧着した。

【００６６】次いで、室温にて１２時間放置させて固化させた後、成形型から脱型し、隔壁と溝底部をなす被覆層を一体的に成形した成形体を被着してなる基板を得た。

【００６７】次に、前記成形体を基板と共に４５０℃の

温度で脱バインダー処理を行い、続いて１２００℃の温度で焼成して焼結一体化し、インク加圧室の構成部材を作製した後、引き出し電極用の空間を溝の端部にスライシング加工にて形成した。

【００６８】その後、隔壁の分極処理を施し、さらに隔壁の側面の上部半分と溝の引き出し電極相当部にスパッタリング法により金電極を形成した。

【００６９】一方、厚さ約３００μｍのチタン酸ジルコン酸鉛系セラミック基板に機械加工によりインク室連結用の穴を形成して上部基板を作製した。

【００７０】また、ポリイミド製のプラスチック板にレーザーでノズル孔を穿孔してノズル板を作製した。

【００７１】かくして、得られた各部材を、エポキシ系接着剤で接着して組み上げ、評価用の剪断モード型のインクジェットヘッドを作製した。

【００７２】まず、隔壁及び流底部をなす被覆層の断面形状を確認すべく、同一仕様で作製したインク加圧室の構成部材を、溝の長手方向に対して直角方向に切断し、その断面を走査線型電子顕微鏡で観察すると共に、流底部をなす被覆層の厚さを測定した。

【００７３】次に、隔壁の接着歩留りは、同一仕様で作製したインク加圧室の構成部材を、溝の長手方向に対して直角方向に切断し、その断面を走査型電子顕微鏡により隔壁の接着状態を観察し、１０個中の良品の個数を１００分率で評価した。

【００７４】さらに、４ｋＨｚで信号電圧を負荷し、Ａ４サイズの普通紙にベタ印刷を行う噴射実験を行い、印刷状態を評価した。

【００７５】その結果、前記評価用の剪断モード型インクジェットヘッドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが４００μｍ、ピッチが１４０μｍ、流底部をなす被覆層は厚さが１５μｍの形状を有しており、隣接するインク加圧室との短絡、即ち、クロストークも認められなかった。

【００７６】また、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さは１０ｍｍであり、溝の形状も完全な矩形状を成していた。

【００７７】さらに、隔壁と基板との接着状態も、クラック、剥離等の形状欠陥は認められず、良好な形状を成しており、接着歩留りは１００％であった。

【００７８】また、インク液滴の噴射実験では、隔壁駆動領域が十分に確保できて液滴も十分に噴射でき、前記接着歩留りも良好なためにインクの噴出速度が２０±１ｍ／ｓｅｃと安定していることと共に、高精細度化が可能な小型のインクジェットヘッドが得られていることが確認できた。

【００７９】（実施例２）実施例１において、流底部をなす被覆層に相当する凹部の厚さが約２０μｍであるステンレス製の開放型の成形型に換えて、溝底部をなす被覆層に相当する凹部の厚さが約２００μｍであるステンレス製の開放型の成形型を使用する以外は、実施例１と同様にして評価用の剪断モード型のインクジェットヘッドを作製し、評価した。

【００８０】その結果、前記評価用の剪断モード型のインクジェットヘッドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが４００μｍ、ピッチが１４０μｍ、溝底部をなす被覆層は厚さが１５０μｍの形状を有し、隣接するインク加圧室とのクロストークも認められなかった。

【００８１】また、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さは１０ｍｍと、溝は完全な矩形状か得られていた。

【００８２】さらに、隔壁と基板との接着状態も、クラック、剥離等の形状欠陥ば認められず、良好な形状を有しており、強度も十分あり、接着歩留りは１００％であった。

【００８３】また、インク液滴の噴射実験で、隔壁駆動領域が十分に確保できて液滴も十分に噴射でき、実施例１と同様にインクの噴出速度も２０±１ｍ／ｓｅｃと安定しており、高精細度化が可能な小型のインクジェットヘッドが得られていることが確認できた。

【００８４】（実施例３）実施例１において、開放型の成形型に換えて、基板を設置可能な隔壁に相当する凹部の幅が約９０μｍ、深さが約５００μｍ、ピッチが約１４０μｍ、流底部をなす被覆層に相当する凹部の厚さが約３００μｍ、溝を形成する凸部の幅が３０μｍ、深さが２５０μｍであるステンレス製の密開型の成形型を使用する以外は、実施例１と同様にして評価用の剪断モード型のインクジェットヘッドを作製し、評価した。

【００８５】その結果、前記評価用の剪断モード型のインクジェットヘッドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが４００μｍ、ピッチが１４０μｍ、被覆層は厚さが２２μｍの形状を有し、隣接するインク加圧室とのクロストークも認められなかった。

【００８６】また、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さは１０ｍｍであり、溝の長手方向の形状も完全な矩形状であった。

【００８７】さらに、隔壁と基板との接着状態も、クラック、剥離等の形状欠陥ば認められず、良好な形状を有しており、強度も十分であり、接着歩留りは１００％で

あった。

【００８８】また、インク液滴の噴射実験で、隔壁駆動領域が十分に確保できて液滴も十分に噴射でき、インクの噴出速度も２０±１ｍ／ｓｅｃと安定しており、高精細度化が可能な小型のインクジェットヘッドが得られていることが確認できた。

【００８９】（実施例４）実施例１における成形用組成物を構成する不飽和ポリエステル樹脂に換えてアクロイル基を有するモノマーを使用する以外は、実施例１と同様にして評価用の剪断モード型のインクジェットヘッドを作製し、評価した。

【００９０】その結果、前記評価用の剪断モード型のインクジェットヘッドドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが３９０μｍ、ピッチが１４０μｍ、被覆層部は厚さが２００μｍの形状を有し、実施例１乃至３と同様、隣接するインク加圧室とのクロストークは全く認められなかった。

【００９１】また、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さば１０ｍｍであり、溝の長手方向の形状も完全な矩形状であった。

【００９２】さらに、隔壁と基板との接着状態も、クラック、剥離等の形状欠陥は認められず、良好な形状を有しており、強度も十分であり、接着歩留りば１００％であった一方、インク液滴の噴射実験では、隔壁駆動領域が十分に確保できて液滴も十分に噴射できると共に、実施例１乃至３と同一の安定した噴出速度を示し、高精細度化が可能な小型のインクジェットヘッドが得られていることが確認できた。

【００９３】（実施例５）実施例１において、流底部をなす被覆層に相当する凹部の厚さが約２０μｍであるステンレス製の開放型の成形型に換えて、流底部をなす被覆層に相当する凹部の厚さが約６２５μｍ、溝を形成する凸部の幅が１５μｍ、深さ６２５μｍで、かつ凸部の頂上に突起を有するステンレス製の開放型の成形型を使用する以外は、実施例１と同様にして評価用の剪断モード型のインクジェットヘッドを作製し、評価した。

【００９４】その結果、前記評価用の剪断モード型のインクジェットヘッドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが４００μｍ、ピッチが１４０μｍ、被覆層は厚さが５００μｍ、溝は幅が２０μｍ、深さが５００μｍの形状を有するとともに、溝底部には一つの切欠溝を有し、隣接するインク加圧室とのクロストークは認められなかった。

【００９５】また、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さは１０ｍｍと、溝は完全な矩形状か得られていた。

【００９６】また、隔壁と基板との接着状態も、クラック、剥離等の形状欠陥ば認められず良好な形状を有しており、強度も十分あり、接着歩留りは１００％であった。

【００９７】さらに、インク液滴の噴射実験で、隔壁駆動領域が十分に確保できて液滴も十分に噴射でき、実施例１と同様にインクの噴出速度も２０±１ｍ／ｓｅｃと安定しており、高精細度化が可能な小型のインクジェットヘッドが得られていることが確認できた。

【００９８】（比較例）まず、厚さ約８００μｍのチタン酸ジルコン酸鉛基板を準備し、該基板上に厚さ５００μｍの紫外線硬化型ドライフィルムをローラーでラミネートした。

【００９９】次いで、前記ドライフィルム上に隔壁に相当する溝幅約９０μｍ、ピッチ約１４０μｍのガラスパターンマスクを設置し、さらにその上から超高圧水銀灯の紫外線で露光した。

【０１００】その後、ガラスパターンマスクを取り除き、２％炭酸ナトリウム水溶液で現像して基板上にドライフィルムの埋め込み用の凹部を形成した。

【０１０１】次に、チタン酸ジルコン酸鉛系セラミック粉とアクリル系バインダ及び高級アルコールから成るペースト状の成形用組成物を、前記凹部に充填して、１２０℃の温度で１５分間乾燥した後、４５０℃の温度で脱バインダー処理を行い、続いて１２００℃の温度で焼成して焼結一体化し、インク加圧室の構成部材を作製した。

【０１０２】以下、実施例１と同様に電極形成、分極、組み立てを行い、評価用の剪断モード型のインクジェットヘッドを作製し、同様に評価した。

【０１０３】その結果、得られた評価用の剪断モード型のインクジェットヘッドは、外形寸法が厚さ２ｍｍ、奥行き１２ｍｍ、幅１２ｍｍから成り、インク加圧室の隔壁は、幅が約７０μｍ、隔壁の高さが４００μｍ、ピッチが１４０μｍを有し、インク加圧室の溝の端部は、流底部から隔壁同様ほぼ直角状に形成されており、溝の端部の引き出し電極相当長さは２ｍｍであり、インク加圧室の溝の長さは１０ｍｍであった。

【０１０４】しかし、隔壁の基部が基板と接する界面に微小クラックが多数発生し、一部は微小クラックが連結して隔壁が基板から剥離し、クロストークしている部分も観察され、接着歩留りも７０％程度であった。

【０１０５】従って、インク液滴の噴射実験では、隔壁が正確に駆動せず、紙面に筋が発生する等の印刷不良が見られると共に、インクの噴射可能なノズル孔からの噴出速度も１５～２１ｍ／ｓｅｃとバラツキが大きく不安定であった。

【０１０６】以上の結果からも明らかなように、比較例

では、隔壁と基板との接着が不良であり、接続信頼性の低いもので、しかも基板との密着不足による微小クラックを生じたりするのに対して、本発明では、いずれも溝の全長が何ら欠陥なく確保でき、小型のインクジェットヘッド自体を形成できるだけでなく噴射特性が優れ、かつ接着歩留りが極めて高く、接続信頼性を高くできることが判る。

【0107】また、隔壁駆動領域を十分に確保でき、インク液滴を十分な圧力で噴射でき、例えば、ラインプリンタヘッドの如き、長いヘッドを容易に製作できる。なお、本発明は前記詳述した実施例に何ら限定されるものではない。

【0108】

【発明の効果】叙上の如く、本発明の印刷装置及びその製造方法によれば、剪断モード型のインク噴射装置を構成するインクジェットヘッドの基板上の隔壁間の流底部を、隔壁と同一材料から成る被覆層により形成することによって、基板に接する隔壁基部の密着面積を増加することができ、基板上に隔壁を強固に接合することができる。

【0109】また、溝底部をなす被覆層に溝を設けることで、被覆層の厚みを厚くしても隔壁の位置精度がばらつくことはなく、基板上に隔壁を強固に接合することができる。

【0110】かくして、いずれも精度の良いインクジェットヘッドを得ることができる。

【0111】さらに、隔壁駆動領域を十分に確保できることから、インクジェットヘッド自体が，小型軽量化され、材料コストも低減できると共に、かかるインクジェットヘッドから成るインク噴射装置の組み込み時の占有面積も大幅に低減され、引いては印刷装置自体の小型化にも寄与することができる。

【0112】また、インクジェットヘッドが小型軽量化されることにより、インクジェットヘッドの移動速度の高速化、位置決め精度の向上が可能となると共に、基板サイズを長尺化することにより、インクジェットヘッドを移動させる必要のないラインプリンタヘッドも簡単に製造することができ、高速、高解像度の印刷も可能となり、要求されている印字や画像、文様等のより高精細度化が可能となり、かつ量産に好適なインクジェットヘッドから成るインク噴射装置を具備した印刷装置が得られる。

【図面の簡単な説明】

【図1】本発明の印刷装置を構成するインク噴射装置に用いられるインクジェットヘッドの一例である溝の長手方向に対して直角方向に切断した要部を示す断面図である。

【図2】本発明の印刷装置を構成するインク噴射装置に用いられるインクジェットヘッドの他の例である溝の長手方向に対して直角方向に切断した要部を示す断面図である。

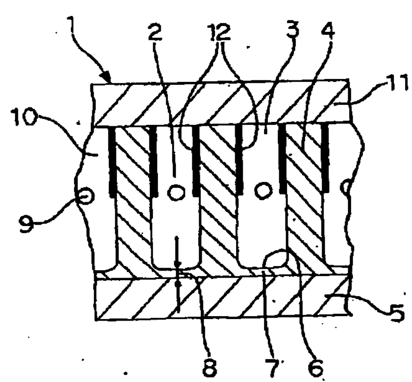
【図3】本発明の印刷装置の製造方法を説明するための、印刷装置の要部を成すインク噴射装置を構成するインクジェットヘッドの製造工程の一例を示す図である。

【図4】本発明の印刷装置の製造方法を説明するための、印刷装置の要部を成すインク噴射装置を構成するインクジェットヘッドの製造工程の他の例を示す図である。

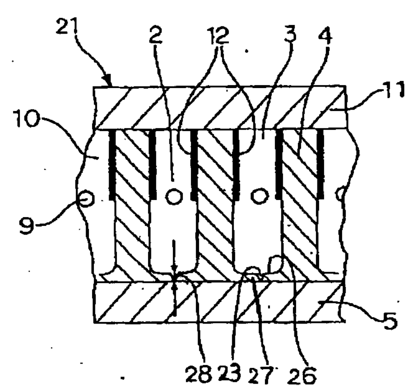
【符号の説明】

1，21：インクジェットヘッド　2：インク加圧室
3：溝　4：隔壁
5：基板　6，26：流底部　7，27：被覆層　8，28：厚さ
9：ノズル孔　10：ノズル板　11：上部基板　12：電極
13：成形型　14：成形用組成物　15：印刷製版
16：成形体

【図1】



【図2】



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CLAIMS

[Claim(s)]
[Claim 1] The septum for forming two or more slots which constitute an ink pressurized room consists of the material which has piezoelectric. It is distorted, make a septum deform with the shearing mode of material in which it has this piezoelectric one, and the capacity of a slot is changed. It is the printer which possessed the ink-jet head injected as a drop from a hole as an ink fuel injection equipment. the nozzle which opens for free passage with a slot the ink supplied to this slot -- The printer characterized by putting the enveloping layer with a thickness of 5-200 micrometers which changes from the same material as this septum to the groove bottom section between the aforementioned septa.
[Claim 2] The septum for forming two or more slots which constitute an ink pressurized room consists of the material which has piezoelectric. It is distorted, make a septum deform with the shearing mode of material in which it has this piezoelectric one, and the capacity of a slot is changed. It is the printer which possessed the ink-jet head injected as a drop from a hole as an ink fuel injection equipment. the nozzle which opens for free passage with a slot the ink supplied to this slot -- The printer characterized by putting the enveloping layer in which it changes from the same material as this septum to the groove bottom section between the aforementioned septa, and thickness has at least one notch slot by 200 micrometers or 500 micrometers.
[Claim 3] The septum which forms two or more slots which constitute an ink pressurized room and which equipped the side with the electrode. The substrate of the couple which was held by this septum at predetermined interval and which counters. the nozzle which seals the open end of the aforementioned slot -- a hole To the form block which has the crevice which forms the enveloping layer of predetermined thickness which is the manufacture method of the printer equipped with the above, and makes the groove bottom section between the aforementioned septum and this septum, and the heights for slots After being filled up with the constituent for fabrication which consists of the material which has piezoelectric and making it solidify, After the enveloping layer which unmolds a form block and makes a septum and the groove bottom section obtains the Plastic solid fabricated in one, a substrate Lamination, an after an appropriate time and ** binder -- and, while calcinating, carrying out the sintering unification of a septum, and the enveloping layer and substrate of the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate to the crowning of a septum after that the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment
[Claim 4] The manufacture method of the printer according to claim 3 characterized by the aforementioned constituent for fabrication containing the organic substance which has polymerization nature.
[Claim 5] The septum which forms two or more slots which constitute an ink pressurized room and which equipped the side with the electrode. The substrate of the couple which was held by this septum at predetermined interval and which counters. the nozzle which seals the open end of the aforementioned slot -- a hole To the form block which has the crevice which forms the enveloping layer of predetermined thickness which is the manufacture method of the printer equipped with the above, and makes the groove bottom section between the aforementioned septum and this septum, and the heights for slots After being filled up with the constituent for fabrication which consists of the material which has piezoelectric and making it solidify, After the enveloping layer which removes the aforementioned form block by chemical preparation, and makes a septum and the groove bottom section obtains the Plastic solid fabricated in one, a substrate Lamination, an after an appropriate time and ** binder -- and, while calcinating, carrying out the sintering unification of a septum, and the enveloping layer and substrate of the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate subsequently to the crowning of a septum the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment
[Claim 6] The septum which forms two or more slots which constitute an ink pressurized room and which equipped the side with the electrode. The substrate of the couple which was held by this septum at predetermined interval and which counters. the nozzle which seals the open end of the aforementioned slot -- a hole To the form block which

has the crevice which forms the enveloping layer of predetermined thickness which is the manufacture method of the printer equipped with the above, and makes the groove bottom section between the aforementioned septum and this septum, and the heights for slots After having been filled up with the constituent for fabrication which consists of the material which has piezoelectric, sticking the substrate and solidifying the aforementioned constituent for fabrication, After chemical preparation removes the aforementioned form block, [a ** binder and] [whether it calcinates and the sintering unification of a septum, and the enveloping layer and substrate of the groove bottom section is carried out, and] Or after carrying out the sintering unification of a septum, and the enveloping layer and substrate of the groove bottom section at the same time it carries out decomposition removal of the aforementioned form block with heat treatment of a ** binder and baking, while forming an electrode in the side of a septum and joining an up substrate subsequently to the crowning of a septum the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment

[Claim 7] The manufacture method of the printer according to claim 5 characterized by the aforementioned form block consisting of the organic resin in which the dissolution or decomposition is possible with chemical preparation or heat treatment.

[Claim 8] The aforementioned form block is the manufacture method of the printer according to claim 5 or 6 characterized by carrying out covering formation of the heights which form the enveloping layer of predetermined thickness in the groove bottom section which has a predetermined cross-section configuration in predetermined height repeatedly while changing a mask pattern for the process which pastes up a photosensitive organic film, doubles the mask pattern of a predetermined configuration on a substrate, and performs exposure and development.

[Claim 9] The septum which forms two or more slots which constitute an ink pressurized room and which equipped the side with the electrode. The substrate of the couple which was held by this septum at predetermined interval and which counters. the nozzle which seals the open end of the aforementioned slot -- a hole After printing the constituent for fabrication which is the manufacture method of the printer equipped with the above, doubles the printing platemaking of a predetermined configuration on a substrate, and has piezoelectric with screen printing and making it solidify, After the enveloping layer which changes printing platemaking, repeats the aforementioned printing and a solidification process, and makes a septum and the groove bottom section fabricates the Plastic solid fabricated in one, a ** binder -- and, while calcinating, carrying out the sintering unification of a septum, and the enveloping layer and substrate of the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate to the crowning of a septum after that the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] a nozzle with a detailed this invention -- it is related with the printer which has the high degree of accuracy and the small lightweight ink-jet head which are used for the ink fuel injection equipment applied to pattern formation etc. in the various printers, the recorder, the facsimile or the textile-printing field, and the ceramic industry field for printing which injects ink as a drop from a hole and forms printing, a picture, etc., and its manufacture method
[0002]
[Description of the Prior Art] In recent years, with osmosis of multimedia, printing is unnecessary, as an interface for printing of the various small lightweight information suitable for the use of small quantity many forms, the various printers of a non impact method which used an ink fuel injection equipment, hot printing equipment, etc. instead of the printer of the conventional impact method are developed, and these use ranges are expanded to various industrial fields.
[0003] Also in the printer of this non impact method, since the formation of many gradation and colorization are easy for the aforementioned ink fuel injection equipment and the running cost is low, possibilities attract attention.
[0004] The ink-jet head which makes the ink pressurized room which generates the pressure for making the nozzle plate which has a hole, and the drop of ink inject main component parts is used. two or more nozzles [fuel injection equipment / ink / aforementioned] -- this ink-jet head -- general -- the nozzle of the aforementioned nozzle plate and this nozzle plate -- it consists of up substrates which constitute the role of the lid which seals the ink pressurized room which prepared the septum and formed the slot on the substrate in order to make the drop of ink inject for every color from a hole, and this ink pressurized room
[0005] Moreover, in the aforementioned ink-jet head, the drops type on demand which injects only the drop of required ink as a method which an ink pressurized room is made to generate a pressure and injects the drop of ink is in use, and, specifically, the kayser type and the thermal jet type are adopted as a typical method.
[0006] A described [above] kayser type is a thing of the up substrate which seals the ink pressurized room which formed two or more parallel slots by the septum which a thin wall is established in part at least, and makes this thin wall transform by the piezoelectric device etc., changes the capacity of the passage of an ink pressurized room, makes an ink pressurized room generate internal pressure, and makes ink inject as a drop.
[0007] Moreover, a described [above] thermal jet type prepares a heating element in the part in the aforementioned ink pressurized room, generates internal pressure using the cubical expansion of the foam generated when boiling the ink in this ink pressurized room, and makes this ink inject as a drop.
[0008] However, since a described [above] kayser type needed to prepare a piezoelectric device etc. in the front face of an up substrate further, it was difficult to miniaturize as an ink-jet head, and in order to add high temperature to ink, thermal resistance was required of ink itself, and since the described [above] thermal jet type required time in order to narrow the selection field of ink or to carry out thermal expansion of the ink, it had problems, like responsibility is inferior.
[0009] Then, the septum for forming the slot arranged in parallel [in order to solve the aforementioned problem] on the substrate which consists of piezoelectric material, [many] The ink pressurized room which consists of the electrode formed in the side of a septum, and the up substrate which is joined to the crowning of a septum and seals a slot, the nozzle corresponding to the open end side of the slot of an ink pressurized room with the slot -- the ink fuel injection equipment of the shearing mode type which consists of the ink-jet head which constitutes the structure which joined the nozzle plate which has a hole is proposed
[0010] the nozzle which pressurized the ink in a slot and was open for free passage into the slot by impressing driver voltage to an electrode, being distorted, making the septum which forms the slot of an ink pressurized room using shearing mode deformation of piezoelectric material deform, and changing the capacity of a slot by this proposal -- the drop of ink is injected from a hole

[0011] Since the ink-jet head which constitutes the ink fuel injection equipment of the shearing mode type of this proposal did not have the need of making a piezoelectric device etc. installing in an up substrate front face, like the conventional kayser type or a thermal jet type and thermal resistance was not required of ink, it was what deserves attention for a miniaturization to become possible, and to excel in responsibility moreover and for high-speed printing to be attained etc.
[0012] However, since the substrate which consists of piezoelectric material is cut although the slot of the ink pressurized room of an ink JIETO head is formed, and the slot is engraved on it in the ink fuel injection equipment of a shearing mode type, rotating cutting implements, such as a diamond blade of the shape of a thin disk piled up the number of necessary sheets, the edge of the obtained slot has constituted the configuration which imprinted the curvature of the cutting implement of the shape of an aforementioned disk.
[0013] Therefore, since it was necessary to be distorted, to make a septum deform and to generate sufficient internal pressure for an ink pressurized room and sufficient septum driver zone had to be secured, in order to obtain a desired injection performance, while the slot needed to be prepared for a long time in consideration of a part for aforementioned un-cutting and the ink-jet head itself became large, there was a fault that material cost increased.
[0014] Moreover, it faced forming a slot in the aforementioned substrate, and by the processing method using cutting implements, such as a diamond blade of the thin shape of an above disk, when cutting conditions were very difficult and a feed rate, the amount of slitting, a rotational frequency, etc. did not suit, there were various problems of a septum causing a chipping, the yield was by no means good and there were some which are hard to be called processing which was suitable for mass production by the low cost.
[0015] Then, the exposure embedding method which cutting waste does not arise in order to solve the aforementioned problem further, and can form a septum in a short time is proposed (refer to JP,7-300381,A).
[0016]
[Problem(s) to be Solved by the Invention] However, the describing [above] exposure embedding method forms the pattern of the crevice of a septum by making a photopolymer constituent into a photoresist layer on a substrate. The obtained septum Plastic solid from disappearing and closing the aforementioned pattern, after filling up obtained opening with the ceramic material for septa Since there was little covering area on the substrate of this septum Plastic solid, the septum exfoliated from the substrate, or it was easy to suffer a loss, and the describing [above] exposure embedding method had the problem of being hard to call it the manufacture method of a low cost with the not necessarily sufficient yield.
[0017]
[Objects of the Invention] It is what was accomplished in order that this invention might solve the aforementioned technical problem. the purpose When the septum formed on the substrate can be pasted up firmly and the adhesion yield can be improved, while defects, such as breakage of a septum, can be reduced and the manufacture yield moreover improves Without a septum driver zone's being able to secure with high precision by the length of a necessary minimum slot, and degrading an injection property greatly It is in offering the printer possessing the ink fuel injection equipment which consists of the ink-jet head which the miniaturization of an ink-jet head and the reduction of cost of were attained, and was suitable for mass production, and its manufacture method.
[0018]
[Means for Solving the Problem] this invention person sets to the ink fuel injection equipment of a shearing mode type, as a result of inquiring wholeheartedly in view of the aforementioned technical problem. By preparing in one the enveloping layer which changes from the same material as a septum to the groove bottom section between the septa on the aforementioned substrate In order to be able to stick the septum on a substrate firmly, and to fabricate, without moreover using tools, such as cutting, for the groove bottom section and the septum between the septa on the aforementioned substrate It found out that the length of the aforementioned slot could be made into necessary minimum as well as the ability to expand a septum driver zone, being able to use as unnecessary the non-cut portion which has the curvature in the conventional processing method, and resulted in this invention.
[0019] Namely, the printer of this invention forms two or more slots which constitute an ink pressurized room from a septum which consists of the material which has piezoelectric. It is distorted, make a septum deform with the shearing mode of material in which it has piezoelectric [which forms the aforementioned septum], and the capacity of a slot is changed. the nozzle which opens for free passage with a slot the ink supplied to this slot -- it is the printer which possessed the ink-jet head injected as a drop from a hole as an ink fuel injection equipment, and is characterized by making an enveloping layer with a thickness of 5-200 micrometers which changes from the same material as this septum to the groove bottom section between the aforementioned septa put
[0020] Moreover, other printers of this invention form two or more slots which constitute an ink pressurized room from a septum which consists of the material which has piezoelectric. It is distorted, make a septum deform with the shearing mode of material in which it has piezoelectric [which forms the aforementioned septum], and the capacity of a slot is changed. It is the printer which possessed the ink-jet head injected as a drop from a hole as an ink fuel

injection equipment. the nozzle which opens for free passage with a slot the ink supplied to this slot -- It changes from the same material as this septum to the groove bottom section between the aforementioned septa, and thickness is characterized by making the enveloping layer which has at least one notch slot by 200 micrometers or 500 micrometers put.

[0021] The manufacture method of the printer of this invention to the form block which has the crevice which forms the enveloping layer of predetermined thickness which makes the groove bottom section between a septum and this septum, and the heights for slots After being filled up with the constituent for fabrication which consists of the material which has piezoelectric by the casting method and making it solidify, After the enveloping layer which unmolds a form block and makes a septum and the groove bottom section obtains the Plastic solid fabricated in one, a substrate and lamination, While carrying out the sintering unification of a ** binder, and the enveloping layer and substrate which calcinate and make a septum and the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate to the crowning of a septum after that after an appropriate time the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment

[0022] especially the constituent for fabrication applied to the aforementioned manufacture method contains the organic substance which has polymerization nature -- it is desirable

[0023] Other manufacture methods of the printer of this invention to moreover, the form block which has the crevice which forms the enveloping layer of predetermined thickness which makes the groove bottom section between a septum and this septum, and the heights for slots After having been filled up with the constituent for fabrication which consists of the material which has piezoelectric, sticking the substrate and solidifying the aforementioned constituent for fabrication, After the enveloping layer which carries out dissolution removal of the aforementioned form block by chemical preparation, and makes a septum and the groove bottom section obtains the Plastic solid fabricated in one, a substrate Lamination, [whether the sintering unification of a ** binder and the enveloping layer which calcinates and makes a septum and the groove bottom section, and the substrate is carried out after an appropriate time, and] To the form block which has the crevice which forms the enveloping layer of predetermined thickness which makes the groove bottom section between a septum and this septum, and the heights for slots After having been filled up with the constituent for fabrication which consists of the material which has piezoelectric, sticking the substrate and solidifying the aforementioned constituent for fabrication, [whether after chemical preparation removes the aforementioned form block, the sintering unification of a ** binder and the enveloping layer which calcinates and makes a septum and the groove bottom section, and the substrate is carried out, and] To or the form block which has the crevice which forms the enveloping layer of predetermined thickness which makes the groove bottom section between a septum and this septum, and the heights for slots After having been filled up with the constituent for fabrication which consists of the material which has piezoelectric, sticking the substrate and solidifying the aforementioned constituent for fabrication, While carrying out the sintering unification of the enveloping layer and substrate which make a septum and the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate subsequently to the crowning of a septum at the same time it carries out decomposition removal of the aforementioned form block with heat treatment of a ** binder and baking the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment

[0024] Especially the form block used also by the manufacture method which dissolves or removes [decomposition] a form block with the aforementioned chemical preparation or heat treatment It is desirable to form with the organic resin in which the dissolution or decomposition with chemical preparation or heat treatment is possible. further as a form block On a substrate, paste up a photosensitive organic film, double the mask pattern of a predetermined configuration, and exposure and development are performed. What carried out covering formation of the heights which form the enveloping layer of predetermined thickness in the groove bottom section which carries out the laminating of this process to predetermined height repeatedly, changing a mask pattern, and has a predetermined cross-section configuration is the most desirable.

[0025] Moreover, the manufacture method of further others of the printer of this invention The constituent for fabrication of the shape of a paste which consists of the material which has piezoelectric is printed with screen printing using the printing platemaking of the predetermined configuration doubled on the substrate. Repeat the process which solidifies and carries out a laminating and the Plastic solid by which the enveloping layer which makes a septum and the groove bottom section on a substrate was fabricated in one is formed. While carrying out the sintering unification of a ** binder, and the enveloping layer and substrate which calcinate and make a septum and the groove bottom section, forming an electrode subsequently to the side of a septum and joining an up substrate to the crowning of a septum after that after an appropriate time the open end side of a slot -- a nozzle -- it is characterized by forming the ink-jet head which joins the nozzle plate which drilled the hole and constitutes an ink fuel injection equipment

[0026]
[Function] From the enveloping layer of predetermined thickness being formed in the groove bottom section which makes between the septa on a substrate with the same material as the septum for forming two or more slots which constitute an ink pressurized room according to the printer and its manufacture method of this invention The septum which the covering area of the septum base which touches a substrate increased, and was formed on this substrate can be pasted up firmly. While the adhesion yield of a septum is improved, a slot can be made shorter than before, for the septum driver zone by shearing mode is secured and acquiring the same ink injection property moreover, and the ink-jet head itself turns small lightweight and also being able to reduce material cost If the occupancy area at the time of inclusion of the ink fuel injection equipment which consists of this ink-jet head is also reduced sharply and is lengthened, it contributes also to the miniaturization of the printer itself.
[0027] Furthermore, when an ink-jet head turns small lightweight, it will contribute also to improvement in the speed of the traverse speed of an ink-jet head, and improvement in positioning accuracy.
[0028]
[Embodiments of the Invention] Hereafter, the printer and its manufacture method of this invention are explained in detail based on a drawing.
[0029] Drawing 1 is the cross section showing the important section cut in the right-angled direction to the longitudinal direction of the slot which is an example of the ink-jet head used for the ink fuel injection equipment which constitutes the printer of this invention.
[0030] The septum 4 which consists of the material which has piezoelectric [which forms two or more parallel slots 3 which l is put on substrate 5 front face, and constitute the ink pressurized room 2 in drawing 1], The enveloping layer 7 of the predetermined thickness 8 which is put on substrate 5 front face and makes the aforementioned septum 4 and the groove bottom section 6 formed in one, It is the ink-jet head which makes the principal part the nozzle plate 10 which has a hole 9. the nozzle joined to the open end side of a slot 3 -- the up substrate 11 connected with an ink room (un-illustrating) is joined to the crowning of a septum 4, and the electrode 12 for drive electric-field impression forms in the side of a septum 4 -- having -- **** -- a nozzle -- the hole 9 is drilled in the seriate by the nozzle plate 10 corresponding to each slot 3
[0031] In this ink-jet head 1 the predetermined thickness 8 of the aforementioned enveloping layer 7 If it is characterized by being 5-200 micrometers in thickness which consists of the same material as a septum 4, and there are few adhesive strength with the substrate 5 of a septum 4 and improvement effects of the adhesion yield and they exceed another side and 200 micrometers when the thickness 8 of the aforementioned enveloping layer 7 is less than 5 micrometers Since a contraction degree with a substrate 5 is different in case the sintering unification of the enveloping layer 7 and substrate 5 which make the septum 4 mentioned later and the groove bottom section 6 is carried out by baking, contraction by the enveloping layer 7 which makes each groove bottom section 6 is checked, and variation occurs in a three slot size.
[0032] Therefore, as long as the ink pressurized room 2 satisfies the aforementioned conditions, and consists of this inventions, and it is distorted, it makes a septum 4 deform with the shearing mode of material in which it has piezoelectric and it can change the capacity of a septum 4 with sufficient repeatability efficiently and correctly, what thing is sufficient as the cross-section configuration.
[0033] Next, other examples of the ink-jet head used for the ink fuel injection equipment which constitutes the printer of this invention are explained to drawing 2 . In addition, the same sign shows the same portion as drawing 1 .
[0034] The septum 4 which consists of the material which has piezoelectric [which forms two or more parallel slots 3 which 21 is put on substrate 5 front face, and constitute the ink pressurized room 2 in drawing 2], The enveloping layer 27 of the predetermined thickness 28 which is put on substrate 5 front face and makes the aforementioned septum 4 and the groove bottom section 26 formed in one, At least one notch slot 23 formed in each enveloping layer 27 which makes the groove bottom section 26, It is the ink-jet head which makes the principal part the nozzle plate 10 which has a hole 9. the nozzle joined to the open end side of a slot 3 -- the up substrate 11 connected with an ink room (un-illustrating) is joined to the crowning of a septum 4, and the electrode 12 for drive electric-field impression forms in the side of a septum 4 -- having -- **** -- a nozzle -- the hole 9 is drilled in the seriate by the nozzle plate 10 corresponding to each slot 3
[0035] In this ink-jet head 21 the predetermined thickness 28 of the aforementioned enveloping layer 27 While being 200 micrometers in thickness which consists of the same material as a septum 4, and 500 micrometers By it being characterized by having 23 for at least one notch slot in an enveloping layer 27, and making thickness 28 of an enveloping layer 27 thicker than 200 micrometers While big adhesive strength can be obtained as compared with the ink-jet head 1 shown in drawing 1 , being able to improve the adhesion yield and being able to join the bigger septum 4 on a substrate 5 By having formed the notch slot 23, in case the sintering unification of the enveloping layer 27 and substrate 5 which make the septum 4 mentioned later and the groove bottom section 26 is carried out

by baking Since contraction of an enveloping layer 27 progresses what the enveloping layer 27 whole had contracted until now toward each septum 4 side, even if it thickens thickness 28 of an enveloping layer 27, the pitch between the septa 4 on a substrate 5 cannot vary greatly, and it can be kept highly precise.
[0036] to the well it is made not to disturb the flow of the ink in a slot 3, without it being desirable to make the depth of the notch slot 23 or more [of the thickness 28 of an enveloping layer 27] into 1/3, and reducing the intensity of a septum 4, in order to acquire such an effect effectively It may be desirable to carry out to 3/4 or less [of the width of face of a slot 3], and as long as the width of face of the notch slot 23 is these size within the limits, what carried out what cross-section configuration is sufficient as it.
[0037] In addition, thickness 28 of the enveloping layer 27 which makes the groove bottom section 26 was set to 500 micrometers or less because the ink-jet head itself would become large and a miniaturization would become difficult, if it became thicker than this.
[0038] And also in the ink-jet head shown in drawing 2 , if satisfy the aforementioned conditions and are constituted, and the ink pressurized room 2 is distorted, makes a septum 4 deform with the shearing mode of material in which it has piezoelectric and can change the capacity of a septum 4 with sufficient repeatability efficiently and correctly like the ink-jet head 1 of drawing 1 , anythings will be available for the cross-section configuration.
[0039] in addition -- although the ink-jet heads 1 and 21 of drawing 1 or drawing 2 showed the example which joined the nozzle plate 10 to the open end side of a slot 3 -- the up substrate 11, and the groove bottom sections 6 and 26 and a substrate 5 -- a nozzle -- what drilled the hole 9 may be used and it cannot be overemphasized that it can change and improve in the range which does not deviate from the range of this invention
[0040] Next, the ink-jet head 1 which constitutes the ink fuel injection equipment which constitutes the manufacture method of the printer of this invention for the important section of a printer, and the manufacturing process of (21) are explained based on drawing 3 .
[0041] the nozzle joined to the l, up substrate [which was joined to the crowning of the septum 4 which consists of the material which has piezoelectric / in which (21) forms two or more parallel slots 3 united with the substrate 5] 11, and open end side of a slot 3 in drawing 3 -- it is the ink-jet head which consists of the nozzle plate 10 which drilled the hole 9
[0042] By the method of ****(ing) the constituent 14 for fabrication which consists of the material which has piezoelectric as the manufacture method of the printer of this invention to the crevice of a form block 13, and fabricating a septum 4 How to consist of the process filled up with the constituent 14 for fabrication which consists of the material which lays a septum 4 and the groove bottom section 6, the enveloping layer 7 that makes (26), and the form block 13 which constitutes the crevice equivalent to (27), and the heights for slot 3 on a substrate 5, and has piezoelectric in the above-mentioned crevice, After being filled up with the constituent 14 for fabrication which consists of the material which prepares a septum 4 and the groove bottom section 6, the enveloping layer 7 that makes (26), and the form block 13 which has a crevice equivalent to (27), and the heights equivalent to a slot 3, and has piezoelectric in the above-mentioned crevice, There is the method of consisting of the process which forces a substrate 5 on this constituent 14 for fabrication.
[0043] In addition, what is necessary is just to form in the heights for slot 3 of a form block 13 the salient which is equivalent to the notch slot 23 beforehand in the process of drawing 3 , in forming the notch slot 23 in the enveloping layer 27 of the ink-jet head shown in drawing 2 .
[0044] Although a well-known doctor blade method and the well-known roll-coater method, print processes, an injection-molding method, etc. can adopt as a means to fill up the aforementioned form block 13 with the constituent 14 for fabrication, it is desirable in that case to carry out deaeration processing before restoration, or to carry out deaeration processing after restoration, and to make it a foam not remain in packing.
[0045] Moreover, in order to stick the form block 13 and substrate 5 which are filled up with the aforementioned constituent 14 for fabrication, you may fill up with and stick the constituent 14 for fabrication to the form block 13 of the closed mold which is made to stick a substrate 5 to the one side of the form block 13 with which both sides were opened wide beforehand, or can install a substrate 5 beforehand.
[0046] Then, although it can be made to solidify with various meanses, such as addition of dryness, cooling, heating, exposure, a reaction accelerator, etc., suitably according to the resin contained in the aforementioned constituent 14 for fabrication If the ** form of the configuration of a septum 4 and the groove bottom section 6, the enveloping layer 7 that makes (26), and the configuration of (27) can finally be carried out It limits, especially the means to solidify does not have **, and in the manufacture method which unmolds especially the form block 13, when solidifying the organic substance which has polymerization nature, it can be most effectively solidified by addition of heating, an exposure, a reaction accelerator, etc., etc. In addition, it is also possible to begin to delete the material layer of the uniform thickness which has piezoelectric [which carried out covering formation] on a substrate 5 by the sandblasting method through a mask pattern, and to form the substrate 5 which comes to cover

Plastic solid 16 which consists of the material which has the groove bottom section 6 between a septum 4 and a septum 4, the enveloping layer 7 which makes (26), and piezoelectric [by which (27) was fabricated in one].
[0047] Furthermore, as shown in drawing 4 , other examples of the manufacturing process of an ink-jet head Print the constituent 14 for fabrication of the shape of a paste containing the material which has piezoelectric first on a substrate 5 by uniform thickness on the whole surface, and laminating printing is repeated after that using the printing platemaking 15 of a predetermined size. Covering fabrication of the groove bottom section 6 between a septum 4 and a septum 4, the enveloping layer 7 which makes (26), and Plastic solid 16 which fabricated (27) in one by the same material can also be carried out on a substrate 5.
[0048] In addition, what is necessary is to form in the printing platemaking 15 the pattern which is equivalent to the notch slot 23 beforehand, and just to make it print the constituent 14 for fabrication of the shape of a paste containing the material which has piezoelectric using this printing platemaking 15 in the process of drawing 4 , in forming the notch slot 23 in the enveloping layer 27 of the ink-jet head shown in drawing 2 .
[0049] The groove bottom section 6 between a septum 4 and a septum 4, the enveloping layer 7 which makes (26), and the substrate 5 on which Plastic solid 16 to which (27) changes from the material which has piezoelectric [which was fabricated in one] was put in this way By calcinating, after performing ** binder 1 processing of well-known conditions, the composition member of the septum 4 united with the substrate 5 which consists of the same material or a different material and ****** 6, the enveloping layer 7 which makes (26), and the ink pressurized room 2 which has (27) is producible.
[0050] Moreover, it can pull out if needed and the slight space for electrodes can also be formed in the edge of a slot 3 with machining.
[0051] Then, polarization processing is performed to a proximal from the apex section of a septum 4, after producing the composition member of the ink pressurized room 2 which has two or more parallel slots 3 united with the substrate 5, it pulls out to the slight space which the septum 4 side reached in part at least, and was established in the edge of a slot 3 with the electrode 12 for drive electric-field impression, and an electrode (un-illustrating) is formed in it by for example, the sputtering method, plating, the vacuum deposition, the ion plating
[0052] subsequently, the composition member of the obtained ink pressurized room 2 -- the up substrate 11 and a nozzle -- the ink-jet head 1 of the shearing mode type of the ink fuel injection equipment which constitutes the printer of this invention, and (21) can be obtained by pasting up and assembling the nozzle plate 10 which drilled the hole 9 with epoxy system adhesives etc., respectively
[0053] In this invention, not to mention the ability to use the material material which has piezoelectric [as a septum 4 / same] as the aforementioned substrate 5, it cannot limit, especially if it can unify after a septum 4 and sintering, and a titanic-acid lead zirconate system ceramic, a zirconia, an alumina, etc. can be mentioned.
[0054] Next, although the various quality of the materials, such as a metal mold, a ceramic type, a plastic pattern, and a rubber die, can be used for the aforementioned form block 13 that what is necessary is just the groove bottom section 6 between the septum 4 of a desired configuration, and a septum 4, the enveloping layer 7 which makes (26), and the thing which can fabricate (27) as the detailed explanation was carried out [aforementioned] In unmolding Plastic solid 16 from a form block 13 A metal mold is the optimal from the processability of a form block 13, and a viewpoint of a dimensional accuracy. again . which a problem does not have in any way even if it consists of assembled dies not to mention one apparatus -- again It is also possible to be able to carry out decomposition removal with the thing which can carry out dissolution removal by chemical preparation, such as a lye, ** binder processing, or heat treatment of baking, and to constitute the aforementioned form block 13. It considers as this form block 13, and the organic resin represented by a wax and the photosensitive organic resist is the optimal then.
[0055] Furthermore, for the reason of improving a mold-release characteristic on the front face of the aforementioned form block 13, a release agent can be applied or surface treatment can also be performed.
[0056] On the other hand, especially if the aforementioned constituent 14 for fabrication is a material which has piezoelectric, it is limited, it does not have **, and although any are sufficient as long as it can use various piezo-electric modes, such as the piezo-electric ****** effect, and the piezo-electric longitudinal effect, the piezo-electric transversal effect, the ceramic material of a titanic-acid lead zirconate system is the optimal especially. In addition, the aforementioned constituent 14 for fabrication can mix the binder solution which consists of a resin, a solvent, etc. in addition to the material which has piezoelectric, and can also add various additives, such as a dispersant and a thickener.
[0057] That that thermoplastic waxes, an acrylic resin, and a butyral system resin can be used as the aforementioned resin contains the organic substance which has the thing, especially polymerization nature of **** can use suitably preferably the monomer in which an unsaturated polyester resin, phenol resin, an epoxy resin, a urethane resin, ultraviolet-rays hardening resin, and a polymerization are possible from a viewpoint which raises the intensity of a septum 4.

[0058] Especially as a means to prepare the aforementioned constituent 14 for fabrication, although it does not limit, a ball mill, a bead mill, 3 rolls, a planetary mold agitator, a planet type agitator, etc. can be used, for example.
[0059] Moreover, especially as a material applicable to the aforementioned electrode 12, although it does not limit, metallic materials, such as copper, silver, gold, platinum, a tungsten, and nickel, a conductive ceramic material of a perovskite system, etc. can use it suitably.
[0060] It is the thing in which the hole 9 was formed. on the other hand, the aforementioned nozzle plate 10 -- laser etc. -- a predetermined size -- punching -- a nozzle -- as the material Any material, such as various plastics metallurgy groups and ceramics, can be used. For example, a polyethylene terephthalate, a polyimide, polyether imide, metals, such as plastics, such as a polyether ketone, polyether sulphone, a polycarbonate, and cellulose acetate, or stainless steel, and a chromium molybdenum steel, aluminum,, although ceramics, such as a **** alumina, and a zirconia, titanic-acid lead zirconate, are mentioned Especially, from a viewpoint of the ease of carrying out of processing, the plastic sheet which consists of a polyethylene terephthalate or a polyimide is suitable.
[0061] in addition -- as the ink made to inject in the printer of this invention -- the solvent of drainage systems, such as a pigment and/or a color, and water, alcohol, -- or although it passed and the solvent of non-drainage systems, such as Korean geisha and toluene, was made into the principal component, it is applicable to all
[0062]
[Example] Next, it evaluated as follows about the printer and its manufacture method of this invention.
[0063] (Example 1) The form block of the open sand mold made from stainless steel whose depth the width of face of the heights from which about 250 micrometers of thickness of the crevice where the width of face of the crevice which is equivalent to a septum first is equivalent to the enveloping layer to which about 90 micrometers and the depth make about 500 micrometers, and a pitch makes the groove bottom section between about 140 micrometers and a septum serve as a slot further is 50 micrometers, and is 250 micrometers was prepared.
[0064] Next, after mixing with titanic-acid lead zirconate system ceramic powder each raw material which consists of an unsaturated polyester resin, ethyl diethylene glycol, and a Nonion system dispersant with a planet type agitator, the constituent for fabrication was prepared through 3 rolls.
[0065] Then, after filling up the aforementioned form block with the constituent for fabrication which carried out degassing, the titanic-acid lead zirconate system ceramic substrate with a thickness of about 300 micrometers was stuck to the predetermined position by pressure from the open section of a form block.
[0066] Subsequently, after making it leave it for 12 hours and making it solidify at a room temperature, it unmolded from the form block and the septum and the substrate which comes to cover the Plastic solid which fabricated in one the enveloping layer which makes the groove bottom section were obtained.
[0067] Next, after having performed ** binder processing at the temperature of 450 degrees C with the substrate, calcinating and carrying out the sintering unification of the aforementioned Plastic solid at the temperature of 1200 degrees C continuously and producing the composition member of an ink pressurized room, the space for drawer electrodes was formed in the edge of a slot by slicing processing.
[0068] Then, polarization processing of a septum was performed and the golden electrode was further formed in the drawer electrode equivalent section of the up half of the side of a septum, and a slot by the sputtering method.
[0069] On the other hand, the hole for ink room connection was formed in the titanic-acid lead zirconate system ceramic substrate with a thickness of about 300 micrometers with machining, and the up substrate was produced.
[0070] moreover, the plastic sheet made from a polyimide -- laser -- a nozzle -- the hole was punched and the nozzle plate was produced
[0071] It pasted up and finished setting up the obtained each part material with epoxy system adhesives in this way, and the ink-jet head of the shearing mode type for evaluation was produced.
[0072] First, while cutting the composition member of the ink pressurized room which produced the cross-section configuration of the enveloping layer which makes a septum and ****** by check ****** and the same specification in the right-angled direction to the longitudinal direction of a slot and observing the cross section with the scanning-line type electron microscope, the thickness of the enveloping layer which makes ****** was measured.
[0073] Next, the adhesion yield of a septum cut the composition member of the ink pressurized room produced by the same specification in the right-angled direction to the longitudinal direction of a slot, observed the adhesion state of a septum for the cross section with the scanning electron microscope, and evaluated the number of the excellent article in ten pieces by 100 molar fractions.
[0074] Furthermore, the load of the signal level was carried out by 4kHz, the injection experiment which performs solid printing in the regular paper of A4 size was conducted, and the printing state was evaluated.
[0075] Consequently, as for the shearing mode type ink-jet head for the aforementioned evaluation, the dimension consisted of 2mm in thickness, the depth of 12mm, and width of face of 12mm, and a short circuit with the ink

pressurized room which the enveloping layer to which the height of about 70 micrometers and a septum makes 400 micrometers, and, as for the septum of an ink pressurized room, a pitch makes [width of face] 140 micrometers and ****** has the configuration whose thickness is 15 micrometers, and adjoins, i.e., a cross talk, was not accepted.

[0076] Moreover, the edge of the slot of an ink pressurized room is mostly formed in the shape of a right angle like the septum from ******, and the drawer electrode equivalent length of the edge of a slot was 2mm, and the length of the slot of an ink pressurized room is 10mm, and had constituted the shape of a rectangle also with the perfect configuration of a slot.

[0077] Furthermore, configuration defects, such as a crack and ablation, were not accepted, but the adhesion state of a septum and a substrate had also constituted the good configuration, and the adhesion yield was 100%.

[0078] Moreover, in the injection experiment of an ink drop, the septum driver zone could fully secure, the drop could also fully be injected, and it has checked that the small ink-jet head in which high-definition-izing is possible was obtained with the aforementioned adhesion yield having the stable spray velocity of ink with 20**1 m/sec in eye a good hatchet.

[0079] (Example 2) In the example 1, it changed to the form block of the open sand mold made from stainless steel whose thickness of the crevice equivalent to the enveloping layer which makes ****** is about 20 micrometers, and the ink-jet head of the shearing mode type for evaluation was produced and evaluated like the example 1 except using the form block of the open sand mold made from stainless steel whose thickness of the crevice equivalent to the enveloping layer which makes the groove bottom section is about 200 micrometers.

[0080] Consequently, as for the ink-jet head of the shearing mode type for the aforementioned evaluation, the dimension consisted of 2mm in thickness, the depth of 12mm, and width of face of 12mm, the enveloping layer to which the height of about 70 micrometers and a septum makes 400 micrometers, and, as for the septum of an ink pressurized room, a pitch makes [width of face] 140 micrometers and the groove bottom section has the configuration whose thickness is 150 micrometers, and a cross talk with an adjoining ink pressurized room was not accepted, either.

[0081] Moreover, the edge of the slot of an ink pressurized room was mostly formed in the shape of a right angle like the septum from ******, the drawer electrode equivalent length of the edge of a slot is 2mm, and 10mm and the slot were obtained in the shape of a rectangle with the perfect length of the slot of an ink pressurized room.

[0082] Furthermore, the adhesion state of a septum and a substrate also had configuration defective **********, such as a crack and ablation, and the good configuration, there was also intensity of enough, and the adhesion yield was 100%.

[0083] Moreover, it has checked that the septum driver zone could fully secure, could also fully inject the drop, the spray velocity of ink as well as an example 1 was stable with 20**1 m/sec, and the small ink-jet head in which high-definition-izing is possible was obtained in the injection experiment of an ink drop.

[0084] The width of face of the crevice which changes to the form block of an open sand mold, and is equivalent to the septum which can install a substrate in an example 1 About 90 micrometers, (Example 3) The thickness of the crevice equivalent to the enveloping layer to which the depth makes about 500 micrometers and a pitch makes about 140 micrometers and ****** About 300 micrometers, The ink-jet head of the shearing mode type for evaluation was produced and evaluated like the example 1 except using the form block **** type [made from stainless steel] whose depth the width of face of the heights which form a slot is 30 micrometers, and is 250 micrometers.

[0085] Consequently, as for the ink-jet head of the shearing mode type for the aforementioned evaluation, the dimension consisted of 2mm in thickness, the depth of 12mm, and width of face of 12mm, and a cross talk with the ink pressurized room which, as for 140 micrometers and an enveloping layer, the height of about 70 micrometers and a septum has [width of face / 400 micrometers and a pitch] the configuration whose thickness is 22 micrometers, and the septum of an ink pressurized room adjoins was not accepted, either.

[0086] Moreover, the edge of the slot of an ink pressurized room was mostly formed in the shape of a right angle like the septum from ******, the drawer electrode equivalent length of the edge of a slot is 2mm, and it had [the length of the slot of an ink pressurized room was 10mm, and] the shape of a rectangle also with the perfect configuration of the longitudinal direction of a slot.

[0087] Furthermore, the adhesion state of a septum and a substrate also had configuration defective **********, such as a crack and ablation, and the good configuration, and was enough, and the adhesion yield was 100%. [of intensity]

[0088] moreover, injection of an ink drop -- real -- it has checked that the septum driver zone could fully secure, could also fully inject the drop, the spray velocity of ink was also stable with 20**1 m/sec, and the small ink-jet head in which high-definition-izing is possible was obtained by harshness

[0089] (Example 4) The ink-jet head of the shearing mode type for evaluation was produced and evaluated like

Example l except using the monomer which changes to the unsaturated polyester resin which constitutes the constituent for fabrication in Example l, and has a bitter taste roil machine.
[0090] Consequently, as for ink-jet HEDDODO of the shearing mode type for the aforementioned evaluation, the dimension consisted of 2mm in thickness, the depth of 12mm, and width of face of 12mm, and the cross talk with the ink pressurized room which, as for the septum of an ink pressurized room, width of face has [the height of about 70 micrometers and a septum / 390 micrometers and a pitch] the configuration 140 micrometers and whose enveloping layer section are 200 micrometers, and thickness adjoins like an example 1 or 3 was not accepted at all.
[0091] moreover, the edge of the slot of an ink pressurized room is mostly formed in the shape of a right angle like a septum from ****** -- having -- **** -- the drawer electrode equivalent length of the edge of a slot -- 2mm -- it is -- the slot of an ink pressurized room -- long -- it was 10mm of mackerel and the configuration of the longitudinal direction of a slot also had the shape of a perfect rectangle
[0092] Furthermore, as for configuration defects, such as a crack and ablation, the adhesion state of a septum and a substrate is not accepted, either. While it had the good configuration, intensity was also enough and it was 100% of adhesion ********, in the injection experiment of an ink drop While the septum driver zone could fully secure and could also fully inject the drop, an example 1 or the same stable spray velocity as 3 was shown, and it has checked that the small ink-jet head in which high-definition-izing is possible was obtained.
[0093] It changes to the form block of the open sand mold made from stainless steel whose thickness of the crevice which is equivalent to the enveloping layer which makes ****** in an example 1 is about 20 micrometers.
(Example 5) The width of face of the heights in which the thickness of the crevice equivalent to the enveloping layer which makes ****** forms about 625 micrometers and a slot in 15 micrometers and a depth of 625 micrometers And the ink-jet head of the shearing mode type for evaluation was produced and evaluated like the example 1 except using the form block of the open sand mold made from stainless steel which has a salient on the top of heights.
[0094] Consequently, the ink-jet head of the shearing mode type for the aforementioned evaluation A dimension consists of 2mm in thickness, the depth of 12mm, and width of face of 12mm. the septum of an ink pressurized room As for the cross talk with the ink pressurized room by which in 500 micrometers and a slot it has one notch slot in the groove bottom section, and 140 micrometers and an enveloping layer adjoin it while having the configuration 20 micrometers and whose depth width of face is 500 micrometers, thickness was not accepted [width of face / the height of about 70 micrometers and a septum] for 400 micrometers and a pitch.
[0095] Moreover, the edge of the slot of an ink pressurized room was mostly formed in the shape of a right angle like the septum from ******, the drawer electrode equivalent length of the edge of a slot is 2mm, and 10mm and the slot were obtained in the shape of a rectangle with the perfect length of the slot of an ink pressurized room.
[0096] Moreover, the adhesion state of a septum and a substrate also had the configuration with good configuration defective **********, such as a crack and exfoliation, and also had intensity of enough, and the adhesion yield was 100%.
[0097] Furthermore, it has checked that the septum driver zone could fully secure, could also fully inject the drop, the spray velocity of ink as well as an example 1 was stable with 20**1 m/sec, and the small ink-jet head in which high-definition-izing is possible was obtained in the injection experiment of an ink drop.
[0098] (Example of comparison) First, the titanic-acid lead zirconate substrate with a thickness of about 800 micrometers was prepared, and the ultraviolet-rays hardening type dry film with a thickness of 500 micrometers was laminated with the roller on this substrate.
[0099] Subsequently, the flute width of about 90 micrometers and the pitch micrometers [about 140 micrometers] glass pattern mask equivalent to a septum were installed on the aforementioned dry film, and it exposed by the ultraviolet rays of a ultrahigh pressure mercury lamp from on the further.
[0100] Then, the glass pattern mask was removed, negatives were developed in sodium-carbonate solution 2%, and the crevice for the embedding of a dry film was formed on the substrate.
[0101] Next, after filling up the aforementioned crevice with the constituent for fabrication of the shape of a paste which consists of titanic-acid lead zirconate system ceramic powder, an acrylic binder, and higher alcohol and drying for 15 minutes at the temperature of 120 degrees C, sintering unification was continuously performed ** binder processing and carried out [calcinated and] at the temperature of 1200 degrees C with the temperature of 450 degrees C, and the composition member of an ink pressurized room was produced.
[0102] Electrode formation, polarization, and the assembly were hereafter performed like the example 1, the ink-jet head of the shearing mode type for evaluation was produced, and it evaluated similarly.
[0103] Consequently, the ink-jet head of the obtained shearing mode type for evaluation A dimension consists of 2mm in thickness, the depth of 12mm, and width of face of 12mm. the septum of an ink pressurized room The height of about 70 micrometers and a septum had 400 micrometers, the pitch had 140 micrometers, as for the edge of the slot of an ink pressurized room, width of face was mostly formed in the shape of a right angle like the septum

from ******, the drawer electrode equivalent length of the edge of a slot was 2mm, and the length of the slot of an ink pressurized room was 10mm.
[0104] However, the minute crack connected the part, many minute cracks occur in the interface to which the base of a septum touches a substrate, and the adhesion yield was [a septum exfoliates from a substrate and / the portion which is carrying out the cross talk was also observed and] also about 70%.
[0105] therefore -- while poor printing of a septum not driving correctly but a line occurring in space in the injection experiment of an ink drop is seen -- the nozzle which can inject ink -- the spray velocity 15 - 21 m/sec, and variation from a hole were greatly unstable
[0106] It turns out that each can be secured by this invention to producing the minute crack adhesion of a septum and a substrate being poor in the example of comparison so that clearly also from the above result, and it being [of connection reliability] low, and according to the shortage of adhesion with a substrate moreover that the overall length of a slot does not have a defect in any way, and the small ink-jet head itself not only being formed but an injection property is excellent, and the adhesion yield is very high, and connection reliability can be made
[0107] Moreover, a septum driver zone can fully be secured, and an ink drop can be injected by sufficient pressure, for example, a long head [like / a line printer head] can be manufactured easily. In addition, this invention is not limited to the example which carried out [aforementioned] the detailed explanation at all.
[0108]
[Effect of the Invention] Like a ** top, by forming ****** between the septa on the substrate of the ink-jet head which constitutes the ink fuel injection equipment of a shearing mode type by the enveloping layer which consists of the same material as a septum, the faying surface product of the septum base which touches a substrate can be increased, and, according to the printer and its manufacture method of this invention, a septum can be firmly joined on a substrate.
[0109] Moreover, even if it thickens thickness of an enveloping layer, the position precision of a septum cannot differ in establishing a slot in the enveloping layer which makes the groove bottom section, and a septum can be firmly joined on a substrate by it.
[0110] In this way, all can obtain an accurate ink-jet head.
[0111] Furthermore, if the occupancy area at the time of inclusion of the ink fuel injection equipment which consists of this ink-jet head is also reduced sharply and is lengthened while the ink-jet head itself turns small lightweight and it can also reduce the department cost of **, since a septum driver zone is fully securable, it can contribute also to the miniaturization of the printer itself.
[0112] Moreover, when an ink-jet head turns small lightweight, while improvement in the speed of the traverse speed of an ink-jet head and improvement in positioning accuracy are attained A line printer head without the need of moving an ink-jet head by long-picture-izing substrate size can also be manufactured easily. The printer possessing the ink fuel injection equipment which printing of of high speed and high resolution is also attained, and high definition-ization of is attained from printing demanded, a picture, a pattern's, etc., and consists of the suitable ink-jet head for mass production is obtained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[View l] It is the cross section showing the important section cut in the right-angled direction to the longitudinal direction of the slot which is an example of the ink-jet head used for the ink fuel injection equipment which constitutes the printer of this invention.
[Drawing 2] It is the cross section showing the important section cut in the right-angled direction to the longitudinal direction of the slot which are other examples of the ink-jet head used for the ink fuel injection equipment which constitutes the printer of this invention.
[Drawing 3] It is drawing showing an example of the manufacturing process of the ink-jet head which constitutes the ink fuel injection equipment which accomplishes the important section of a printer for explaining the manufacture method of the printer of this invention.
[Drawing 4] It is drawing showing other examples of the manufacturing process of the ink-jet head which constitutes the ink fuel injection equipment which accomplishes the important section of a printer for explaining the manufacture method of the printer of this invention.
[**** of a sign]
1 21: Ink-jet head 2: Ink pressurized room 3: Slot 4: Septum
5: Substrate 6 26: ****** 7 27: Enveloping layer 8 28: Thickness
9: a nozzle -- hole 10: -- nozzle plate 11:up substrate 12: -- electrode
13: Form block 14: Constituent for fabrication 15: Printing platemaking 16: Plastic solid

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[Translation done.]